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THREE NEW SPECIES OF FROGFISHES
FROM THE INDIAN AND PACIFIC OCEANS
WITH NOTES ON OTHER SPECIES
(FAMILY ANTENNARIIDAE)

By LEONARD P. SCHULTZ

The purposes of this paper are: (1) to evaluate further certain diagnostic characters of frogfishes; (2) to call attention to nomenclatural changes; (3) to describe three new species; (4) to record specimens and data not available at the time I reviewed the family Antennariidae (Proc. U.S. Nat. Mus., vol. 107, no. 3383, pp. 47-105, 8 figs., 14 pls., 1957).

I am grateful to the staffs of the California Academy of Sciences (CAS), San Francisco, California; of the University of Hawaii (UH), Honolulu, Hawaii; and of the Division of Systematic Biology, Stanford University (SU), for permitting me to study the specimens in their collections. The following abbreviations, refer to other specimens recorded in this paper: RMNH (Rijksmuseum van Natuurlijke Historie, Leiden) and USNM (United States National Museum).

Diagnostic Characters

The study of additional material, not available previously, has enabled me to reconsider certain unsolved problems as well as to investigate new ones. My description of the bait as a "non-filamentous simple slender tentacle" has led to misinterpretation. This type of bait is considered to be a simple or unbranched central stalk, varying from a single slender threadlike tentacle to one that is somewhat fleshy, as contrasted to a tuft of tentacles or a bulbous base with tentacles. In addition, it should be understood that the bait is extensible and, when contracted, may be fleshy in nature; yet it retains the single central stalk.

Further attention has been given to the evaluation of the presence or absence of warts on the skin of frogfishes as a taxonomic character. Two species with warts were described by Bleeker, *Antennarius phymatodes* and *A. oligospilos*. During my examination of specimens of *A. moluccensis* Bleeker in the collection of the University of Hawaii, I encountered an abnormal specimen with "warts"—UH 403, collected at Diamond Head, Oahu, measuring 87 mm. from tip of snout to base of caudal fin. Dr. Victor G. Springer informed me that he investigated "warts" on a large frogfish collected in the Gulf of Mexico and that the warts were encysted nematodes. Thus, "warts" on the skin of frogfishes may be of questionable value in distinguishing species.

Briggs (Copeia, vol. 2, p. 440, 1962) distinguished *Antennatus reticularis* from *A. strigatus* on supposed differences in the length of the illicium in relation to the length of the second dorsal spine and on the characteristic that the esca is blunt and lobed instead of lanceolate.

Rosenblatt (Copeia, vol. 2, pp. 462-464, 1963) investigated this problem by measuring the length of the illicium and the second dorsal spine on 62 specimens, then analyzing his data statistically. He concluded that "only one population was represented in the sample." He compared the pectoral ray counts of *A. strigatus* and *A. bigibbus* and concluded that the eastern Pacific population of *A. strigatus* was distinct from the western Pacific population of *A. bigibbus*. This leaves the two species as valid and in agreement with the conclusions of Schultz (1957).

The importance of fin ray counts in the identification of frogfishes is evident when one studies table 1. I have added, therefore, the new counts made on the specimens listed below to my table 1 published in 1957. Additional counts are recorded from other specimens mentioned elsewhere in this paper as well as some furnished by Dr. Richard Rosenblatt.

Table 1 includes the nomenclatural changes discussed in this report.

Specimens Examined

Antennarius altipinnis

SU 30045, Taruna, Sangi Island, Sangir Islands, Herre, June 24, 1928, 31 mm.
 SU 27238, Sitankai, Sulu, Philippines, Herre, August 7, 1931, 32 mm.
 SU 27239, Dumaguete, Philippines, Herre, 19 mm.

Antennarius avalonis

CAS [no number], Guaymas, Sonora, Mexico, February 1951, 200 mm.
 CAS 6627, latitude 0°55'S., longitude 90°31'W., Hancock Expedition, dredge
 58-60 fathoms, Jan. 26, 1934, 68 mm.
 CAS [no number], Guaymas, Mexico, D. A. Simpson, April 2, 1946, 3 speci-
 mens, 32-50 mm.
 SU 9979, Santa Catalina Island, California, holotype of *A. avalonis* Jordan
 and Starks, 267 mm.
 SU 16586, San Carlos Bay, Sonora, Mexico, June 1, 1950, 44 mm.
 SU 14968, Rocky Bluff Bay, Sonora, Mexico, 13 mm.

TABLE 1.—Counts recorded for species of *Antennariidae*

Genera, subgenera, and species	Number of fin rays																		
	Soft dorsal					Anal				Pectoral†									
	11	12	13	14	15	16	6	7	8	9	10	7	8	9	10	11	12	13	14
<i>Tathicorpus</i>																			
<i>bulleri</i> *	3	-	-	-	-	-	-	3	-	-	-	3	-	-	-	-	-	-	-
<i>bulleri</i>	1	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-
<i>Trichophryne</i>																			
<i>rosaceus</i>	-	2	-	-	-	-	-	1	1	-	-	-	-	4	-	-	-	-	-
<i>mitchelli</i> *	-	-	1	2	-	-	-	-	2	1	-	-	-	1	2	-	-	-	-
<i>Nudiantennarius</i>																			
<i>subteres</i>	-	1	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-	-	-
<i>Abantennarius</i>																			
<i>duescus</i>	-	2	-	-	-	-	-	2	-	-	-	-	4	-	-	-	-	-	-
<i>analis</i>	-	1	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-	-	-
<i>Rhycherus</i>																			
<i>filamentosus</i> *	-	-	3	-	-	-	-	-	3	-	-	-	-	-	3	-	-	-	-
<i>Histiophryne</i>																			
<i>bougainvilli</i> *	-	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	-	-	-
<i>scortea</i> *	-	-	-	-	3	-	-	-	3	-	-	-	-	1	2	-	-	-	-
<i>Echinophryne</i>																			
<i>crassispina</i> *	-	-	-	-	1	1	-	-	2	1	1	-	-	1	2	-	-	-	-
<i>glauerti</i> *	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-	-
<i>Phrynelox</i>																			
<i>Phrynelox</i>																			
<i>striatus</i> *	-	1	1	-	-	-	1	1	-	-	-	-	-	2	-	-	-	-	-
<i>striatus</i>	-	2	-	-	-	-	-	1	1	-	-	-	-	4	-	-	-	-	-
<i>melas</i> *	-	2	-	-	-	-	1	1	-	-	-	-	2	-	-	-	-	-	-
<i>scaber</i>	1	49	1	-	-	-	-	50	1	-	-	-	-	5	61	-	-	-	-
<i>lochites</i> , new species	-	4	-	-	-	-	-	4	-	-	-	-	-	2	6	-	-	-	-
<i>Triantennatus</i>																			
<i>cunninghami</i>	-	1	-	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-
<i>zebrinus</i>	-	6	-	-	-	-	1	5	-	-	-	-	-	10	1	-	-	-	-
<i>atra</i>	-	5	-	-	-	-	-	5	-	-	-	-	-	9	-	-	-	-	-
<i>noz</i>	-	7	-	-	-	-	-	7	-	-	-	-	-	1	12	-	-	-	-
<i>tridens</i>	-	42	1	-	-	-	-	43	-	-	-	-	-	7	66	4	-	-	-

TABLE 1.—Counts recorded for species of *Antennariidae*—Continued

Genera, subgenera, and species	Number of fin rays																		
	Soft dorsal					Anal					Pectoral†								
	11	12	13	14	15	16	6	7	8	9	10	7	8	9	10	11	12	13	14
<i>Antennatus</i>																			
<i>Antennatus</i>																			
<i>bigibbus</i>	-	11	3	-	-	-	-	12	1	-	-	-	-	-	2	27	-	-	-
<i>strigatus</i>	-	9	-	-	-	-	-	9	-	-	-	-	-	1	13	2	-	-	-
<i>Golem</i>																			
<i>cryptacanthus</i>	-	1	1	-	-	-	-	2	-	-	-	-	2	-	-	-	-	-	-
<i>Lophiocharon</i>																			
<i>Lophiocharon</i>																			
<i>caudimaculatus</i>	-	1	29	-	-	-	-	28	2	-	-	-	-	46	2	-	-	-	-
<i>Uniantennatus</i>																			
<i>campylacanthus</i>	1	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-
<i>horridus</i>	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	2	-	-	-
<i>horridus*</i>	-	2	2	-	-	-	-	-	3	1	-	-	-	-	1	2	1	-	-
<i>tenebrosus*</i>	-	1	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-
<i>tenebrosus</i>	-	1	-	-	-	-	-	1	-	-	-	-	-	-	2	-	-	-	-
<i>Antennarius</i>																			
<i>Fowlerichthys</i>																			
<i>radiosus</i>	-	1	79	6	-	-	-	-	82	1	-	-	-	-	-	-	-	107	5
<i>radiosus*</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	51	5
<i>avalonis</i>	-	2	29	1	-	-	-	-	30	1	-	-	-	-	-	-	-	59	-
<i>sarasa*</i>	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-
<i>ocellatus</i>	-	-	17	-	-	-	-	-	17	-	-	-	-	-	3	26	3	-	-
<i>Antennarius</i>																			
<i>hispidus</i>	-	1	3	-	-	-	-	4	-	-	-	-	-	8	-	-	-	-	-
<i>moluccensis*</i>	-	-	2	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	-
<i>moluccensis</i>	-	1	13	-	-	-	-	5	9	-	-	-	-	9	17	-	-	-	-
<i>leucosoma*</i>	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-
<i>pardalis</i>	?1	-	-	-	-	-	-	-	28	-	-	-	-	-	21	-	-	-	-
<i>chironectes</i>	1	14	1	-	-	-	-	2	13	-	-	-	-	-	27	-	-	-	-
<i>multiocellatus</i>	1	6	-	-	-	-	-	1	6	-	-	-	-	13	-	-	-	-	-
<i>phymatodes</i>	1	3	-	-	-	-	-	4	-	-	-	-	-	6	-	-	-	-	-
<i>japonicus, new species</i>	-	1	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-
<i>indicus, new species</i>	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-
<i>sanguineus</i>	-	-	8	-	-	-	-	6	2	-	-	-	-	-	13	3	-	-	-
<i>drombus</i>	1	21	3	-	-	-	-	24	1	-	-	-	-	-	12	36	1	-	-
<i>coccineus</i>	-	24	-	-	-	-	-	1	22	-	-	-	-	3	43	1	-	-	-
<i>bermudensis</i>	-	2	-	-	-	-	-	2	-	-	-	-	-	2	2	-	-	-	-
<i>dorehensis*</i>	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-
<i>notophthalmus*</i>	-	3	-	-	-	-	-	3	-	-	-	-	-	3	1	-	-	-	-
<i>notophthalmus</i>	-	4	-	-	-	-	-	4	-	-	-	-	-	7	1	-	-	-	-
<i>terrucosus</i>	-	2	-	-	-	-	-	2	-	-	-	-	-	-	4	-	-	-	-
<i>allipinnis</i>	1	20	1	-	-	-	-	19	3	-	-	-	-	42	5	-	-	-	-
<i>pauciradiatus</i>	-	13	-	-	-	-	-	12	1	-	-	-	2	21	1	-	-	-	-
<i>nummifer</i>	-	22	-	-	-	-	-	22	-	-	-	-	-	34	4	-	-	-	-
<i>Histrio</i>																			
<i>histrio</i>	3	32	2	-	-	-	-	30	2	-	-	-	-	2	72	4	-	-	-

*Counts recorded from literature.

†Counts for both pectorals included when the number exceeds the count for the anal or dorsal rays.

Antennarius chironectes

- CAS [no number], Honolulu, E. M. Ehrhorn, 1915, 18 mm.
CAS 6371, Honolulu, E. M. Ehrhorn, 92 mm.
CAS 7400, Honolulu, A. Seale, 1935, 93 mm.
SU 20463, Cagayancillo, Philippines, 63 mm.
SU 8468, Honolulu, *Albatross*, 1902, 2 specimens, 52 and 101 mm.
SU 8439, Laysan Island, holotype of *A. laysanius* Jordan and Snyder, 69 mm.
UH 2338, Waiamae, Oahu, Aug. 12, 1955, 150 mm.

Antennarius coccineus

- CAS [no number], Pago Pago, Samoa, A. Seale, May 1929, 72 mm.
CAS [no number], Pago Pago, Samoa, A. Seale, May 1929, 70 mm.
UH 1159, Hull Island, Phoenix Islands, July 12, 1950, 74 mm.

Antennarius drombus

- UH 1775, Hauula Park, Oahu, A. Tester, Jan. 21, 1953, one specimen
UH 531, Waikiki, Oahu, Cuttress, April 4, 1950, one specimen
UH 1832, Diamond Head, Oahu, one specimen
UH 1227, Waialea School, Oahu, Feb. 4, 1951, two specimens
UH 816, Diamond Head, Oahu, May 16, 1950, two specimens
UH 1995, Waimea, Oahu, July 25, 1955, 62 mm.
UH 338, Hauula Park, Oahu, June 28, 1949, 26 mm.
UH 1751, Waikiki, Oahu, 40 mm.

Antennarius multiocellatus

- SU 52342, Port of Fortaleza, Brazil, Mucuripe, Feb. 23, 1945, 50 mm.

Antennarius moluccensis

- CAS [no number], Hawaii, Thayer, Sept. 23, 1909, 111 mm.
CAS [no number], Hawaii, 173 mm.
SU 8455, Honolulu, 53 mm.
SU 8458, Honolulu, *Albatross*, 1902, 84 mm.
UH 148, off Oahu, 162 mm.
UH 1995, Waimea, Oahu, July 25, 1955, 36 mm.
UH 268, Waimea, Oahu, Feb. 22, 1949, 1 specimen
UH 403, Diamond Head, Oahu, Dec. 15, 1949, 87 mm.

Antennarius nummifer

- SU 7600, Misaki, Japan, holotype of *A. sanguifluus* Jordan, 44 mm.

Antennaries notophthalmus

- SU 27241, Unisan, Tayabas Province, Luzon, Philippines, Herre, Feb. 15, 1924, 2 specimens, 52 mm.

Antennarius sanguineus

- SU 14967, Cleopha Island, Tres Marias Islands, Mexico, Feb. 23, 1940, 31.5 mm.

Antennatus bigibbus

- SU 27236, Dumaguete, Philippines, Herre, June 20-26, 1931, 2 specimens, 23 and 34 mm.
SU 29562, Mabini, Batangas, Philippines, Herre, March 1933, 34 mm.
SU 8461, Honolulu, O. P. Jenkins, *Albatross*, 3 specimens, 15 and 19 mm.
SU 3247, Honolulu, O. P. Jenkins, 5 specimens, 19 and 24 mm.
UH 338, Hauula Park, Oahu, June 28, 1949, 33 mm.
UH 2100, three miles west of Lahaina, Maui, Aug. 5, 1955, 33 mm.

Antennatus strigatus

- CAS W56-236, Clipperton Island, northeast side, Oct. 22-29, 1956, 34.3 mm.
CAS W58-296, Clipperton Island, Aug. 20, 1958, 20 mm. [abnormal dorsal fin with last 4 rays branched]
CAS W58-291, Clipperton Island, west end, Aug. 16, 1958, 22 mm.

Lophiocharon caudimaculatus

- CAS [no number or locality], 5 specimens, 57 to 92 mm.
SU 39498, Singapore, Herre, Oct. 10, 1940, 2 specimens, 45 and 83 mm.
SU 30651, Singapore, Herre, March 14, 1934, 4 specimens, 39 to 81 mm.
SU 27872, Sandaken, British North Borneo, Herre, July 3, 1929, 3 specimens, 65 to 87 mm.
SU 32738, Singapore Harbor, Herre, May 7, 1937, 3 specimens, 53 to 69 mm.
SU 35781, Singapore Market, Herre, May 1937, 2 specimens, 84 and 85 mm.
SU 30652, Singapore, Herre, 2 specimens, 52 and 80 mm.
SU 20204, Cuyo, Philippines, R. C. McGregor, holotype of *A. lithinostomus* Jordan and Richardson, 84 mm.

Phrynelox atra

- CAS [no number or locality, identification uncertain], 82 mm.
SU 9234, Port Jackson, Australia, 1 specimen
SU 3259, Honolulu, Jenkins, 1889, 60 mm.

Phrynelox nox

- SU 7601 Japan, cotype of *A. nox* Jordan, 61 mm.
SU 7603, Nagasaki, Japan, holotype of *A. nox* Jordan, 84 mm.
SU 7599, Misaki, Japan, two cotypes of *A. nox* Jordan, 58 and 60 mm.

Phrynelox scaber

- CAS 8819, Green Turtle Bay, Bahamas, 67 mm.

Phrynelox striatus

- SU 9138, Port Jackson, Australia, 106 mm.
SU 20725, Lake Illawarra, Australia, 87 mm. [bait is abnormal with 5 branches]

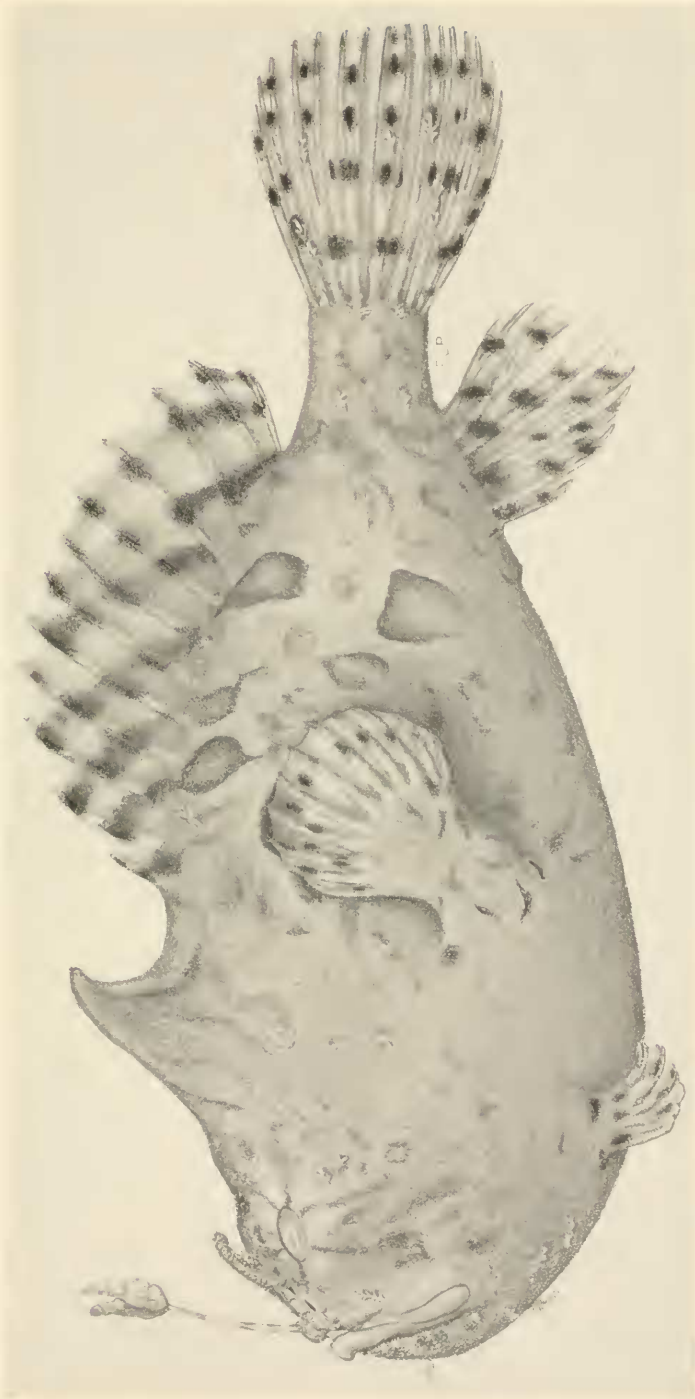


PLATE 1.—*Phrynelox lochites*, holotype, SU 38194 (drawn by Mrs. Fanny Phillips).



PLATE 2.—*Antennarius japonicus*, holotype, SU 26796 (drawn by Mrs. Fanny Phillips.)

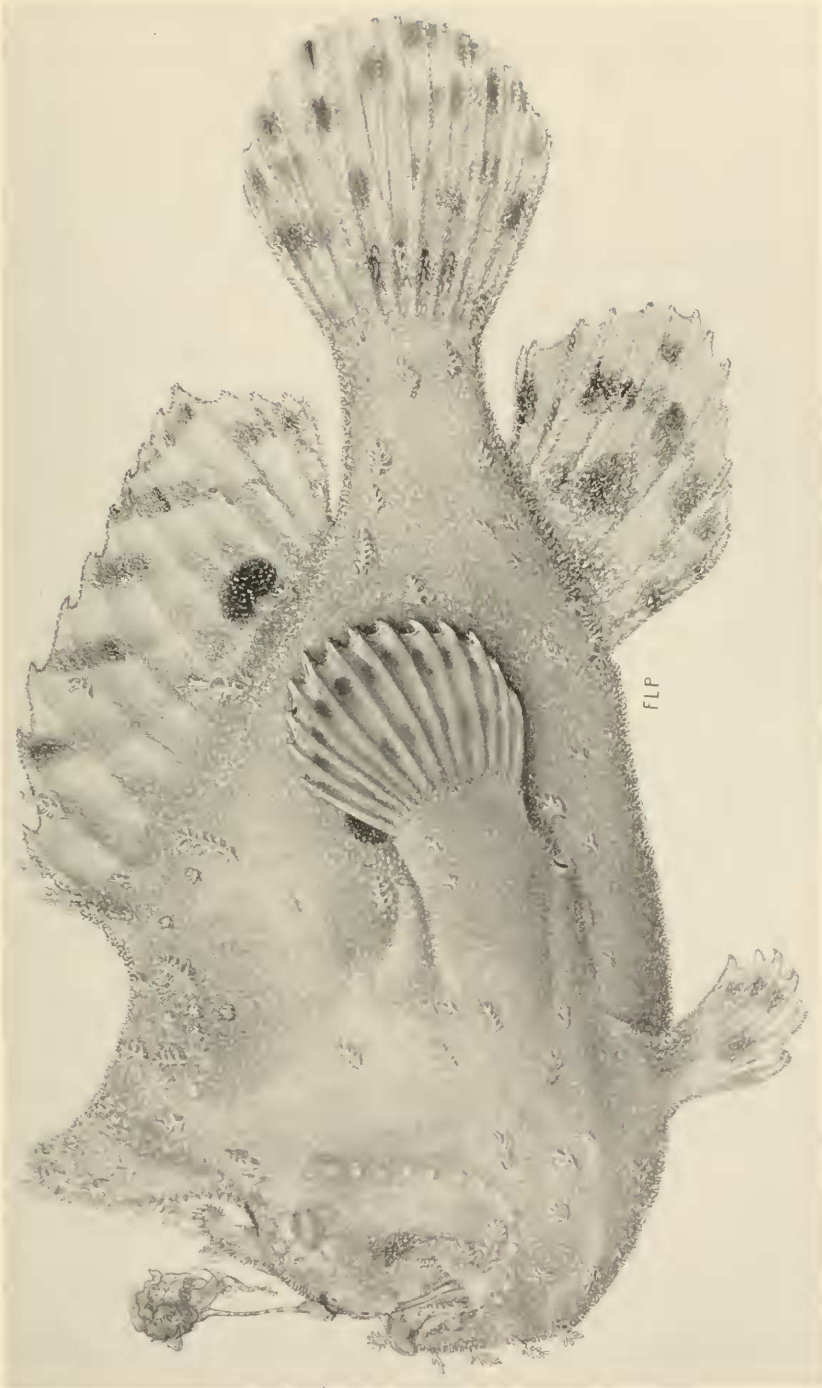


PLATE 3.—*Antennarius indicus*, holotype, SU 40090 (drawn by Mrs. Fanny Phillips).

Phrynelox tridens

CAS [no number], Tateyama Bay, Chiba Prefecture, Japan, Terazaki, Aug. 29, 1946, 59 mm.

CAS [IU 10680] Misaki, Sagami, Japan, Jordan and Snyder, 3 specimens, 49 to 52.5 mm.

SU 32414, Tinghai, Chusan Island, Cheking Province, China, 2 specimens, 47 and 63 mm.

SU 25636, Nagasaki, Japan, 39 mm.

SU 7227, Nagasaki, Japan, 18 specimens, 27 to 59 mm. [one specimen has 4 tentacles]

SU 7228, Wakanoura, Japan, 7 specimens, 53 to 78 mm.

SU 23424, Wakanoura, Japan, 5 specimens, 42 to 59 mm.

Nomenclatural Changes

Three new frogfish names have been published since my review. Cadenat (Bull. Inst. Francais Afrique Noire, vol. 21, ser. A., no. 1, pp. 361-385, figs. 1-26, 1959) described *Antennarius (Fowlerichthys) senegalensis*, *A. (Triantennatus) delaisi*, and *A. (T.) occidentalis* as new species from off the west coast of Africa.

Golem Whitley

Xenophrynichthys Schultz (synonym).

The generic name *Golem Whitley* (type species, *Antennarius cryptacanthus* Weber), published May 8, 1957 (Proc. Roy. Zool. Soc. New South Wales, p. 70) has priority over *Xenophrynichthys* Schultz (Proc. U.S. Nat. Mus., vol. 107, no. 3383, p. 81, November 1, 1957), both with the same type species.

Antennarius radiosus Garman

Kanazawaichthys scutatus Schultz (synonym).

In 1957 (op. cit., p. 63) I described *Kanazawaichthys scutatus* on prejuvenile specimens, characterized by having two pairs of enlarged bony plates on the head. Hubbs (Copeia, no. 4, pp. 282-285, 1958), with additional specimens and aided by me in a restudy of still more specimens, concluded that *K. scutatus* is the prejuvenile of *A. radiosus*, an opinion with which I concur.

Maul (Bocagiana, Mus. Mun. Funchal, no. 1, p. 15, 1959) records a large specimen of *A. radiosus* from Madeira, and Palmer (Ann. Mag. Nat. Hist., ser. 13, vol. 3, pp. 149-151, 1960) records a prejuvenile *A. radiosus*, 13 mm. in standard length, off the West Coast of Ireland, 54°10' N., 12°10' W.; thus, this western Atlantic species occasionally occurs in the eastern part of the Atlantic Ocean.

Lophiocharon Whitley

Plumantennatus Schultz (synonym).

Lophiocharon caudimaculatus (Rüppell)

Antennarius asper Macleay (synonym).

The main character I used for the separation of *L. caudimaculatus* (subgenus *Lophiocharon*) and *L. asper* (type of the subgenus *Plumantennatus*) was a supposed difference in the bait, a simple tentacle in the former and a plumelike bait in the latter. I now find the nature of the bait to be variable, from simple to plumelike, and, therefore, I synonymize *Antennarius asper* Macleay with *L. caudimaculatus* (Rüppell) and the subgenus *Plumantennatus* Schultz (1957, p. 89) with *Lophiocharon* Whitley.

The usual color pattern of *L. caudimaculatus* is that figured by Schultz (1957, pls. 6, A, D, and 8, C) with or without an ocellate spot just behind the midbase of the soft dorsal fin; otherwise, the entire fish is brown-speckled or reticulated with brown. The chief distinguishing coloration, however, is in the caudal fin and consists of white or clear spots encircled with brown or blackish pigment.

The following specimens were studied at the Department of Systematic Biology, Stanford University (SU): SU 35781, Singapore Market, May 1937, A. W. Herre, two, 84 and 85 mm. standard length; 30652, Singapore, A. W. Herre, two, 52 and 80 mm.; 20204 (holotype of *A. lithinostomus* Jordan and Richardson), Cuyo, Philippine Islands, R. C. McGregor, 84 mm.; 39498, Singapore, October 10, 1940, A. W. Herre, two, 45 and 83 mm.; 30651, Singapore, March 14, 1934, A. W. Herre, four, 39 to 81 mm.; 27872, Sandaken, British North Borneo, July 3, 1929, A. W. Herre, three, 65 to 87 mm.; 32730, Singapore Harbor, May 7, 1937, A. W. Herre, three, 53 to 68 mm. At the California Academy of Sciences (CAS) (without number or locality), five specimens measured 57 to 92 mm.

Among the 26 specimens examined, I find that 6—SU 30652 (2), 32730 (3), and CNHM 47248 (1)—represent a black color phase described as follows: general background coloration black, tentacle barred, bait white; white saddle in front of first soft ray of dorsal fin reaching to level of eye; white blotches just behind corner of mouth, above base of pectoral fin, near tips of third dorsal spine, near tips of rays of caudal, pectoral, and posterior rays of both soft dorsal and anal fins; white bar between rear of bases of soft dorsal and anal fins, and another white bar across base of caudal fin rays; sometimes rear third of caudal fin white and posterior margins of pectoral, pelvic, anal, and dorsal fins white; a few circular white spots may, or may not, occur in black area on middle of caudal fin.